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## GENETICS AND EUGENICS: A CONSIDERATION OF THE RELATION OF ANIMAL EXPERIMENTATION TO HUMAN INHERITANCE AND INFANT CONSERVATION<sup>1</sup>

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DURING the past decade there has developed an activity in the experimental and analytical study of the laws of inheritance in plants and animals unprecedented in the history of biology. In the same period we have seen the new science of eugenics rising rapidly to a position already certainly very respectable, and giving promise, because of its great intrinsic importance of some day perhaps becoming the crowning one of the biological sciences.

It is obvious that these two great developments of biology, genetics and eugenics, are directly and intimately related. It is the purpose of the present paper briefly to discuss certain implications of this relationship.

In a general way the importance for the study of human inheritance of genetic investigations of animals is evident, since it is only through these that we may by experimentation gain a definite knowledge of the basic laws of inheritance. In the nature of the case our knowledge of human inheritance must always remain in large degree inferential, in distinction to the direct and positive knowledge which we may get regarding lower animals and plants. Definite and comprehensive experiments in breeding men are, broadly speaking, impossible. Nature and social circumstances, it is true, have led to many experiments; but the results of such "natural" experiments are, and must always be, extremely unsatisfactory from the standpoint of

<sup>1</sup> A paper read before the American Association for the Study and Prevention of Infant Mortality at the annual meeting in Chicago, November 16-18, 1911. The paper as here printed has been slightly changed from that read.

scientific analysis, because such a large portion of the pertinent and necessary data is lacking. As an illustration of the difficulty I need only mention here the inheritance of skin colour in man. One would be inclined to say off-hand that it ought to be the simplest of matters to find out in this country (the United States) of all others, just how pigmentation is inherited in crosses of black and white races. Yet the question of whether skin colour segregates (in the Mendelian sense) in such crosses is a matter by no means definitely settled, and to all appearances not likely to be for some time to come, because of its complications and the impossibility of controlled experimentation.

The statistical method is practically the only one by which the inheritance of many human characters can be directly investigated. This is unfortunate in several ways, but chiefly because it means that—in so far—the only sort of direct knowledge of human inheritance which we are able to get is just the sort which is not very useful. More than anywhere else it is true that in regard to human inheritance it is knowledge respecting the individual rather than the mass which we want, and which is most useful. Let the meaning be clear here: We wish to find the basic general laws of human inheritance. But the real, compelling, human reason why we want to know these is so that we may be able to predict with precision what will happen in the individual case. The statistician will tell us that all this is nonsense—a chimerical dream—because in inheritance the results are determined by an indefinitely vast number of small causes all acting together, and hence anything like accurate prediction of results in the individual case is quite out of the question. This argument has plausibility and has carried weight. Latterly, however, it has lost much of its force. It is perfectly true that by statistical methods it is apparently impossible to get at any general law whereby one can predict the coat colour of offspring, horses or dogs (for example) following particular, individual matings. Yet it is evident that the difficulty here does not inhere in the nature of the case but rather in the nature of the methods. By direct and “individualistic” methods of research a general law has been worked out where-

from one is, in point of fact, able to predict the coat colour of horses and dogs in the individual case.

This discussion brings us to the writer's conception of the sort of relation between genetics and eugenics which would seem to be most natural (which is to say, scientific) and consequently most useful and helpful. This relation would involve the following propositions, which, because of lack of time, may be categorically stated, without specific references to the literature in support of the contentions made.

1. That it is *a priori* probable, and so far as the observational data go is *a posteriori* the fact, that the fundamental and essential laws of inheritance are the same for man and at least the higher vertebrates and that therefore what is found to be true for one may be expected to apply to the other (with such differences in matters of detail as are involved in differences of structure, physiology, etc., in the particular case).

2. That it is to be expected that matters in regard to inheritance which are new in principle and fundamental and general in character will in the future, as they have been in the past, more often be discovered through genetic studies on animals and plants than through those on man. This is probably because (a) direct experimental analysis by breeding can practically only be done with lower forms, and (b) because it is to this sort of analysis in terms of the individual that experience indicates we are to look for fundamental advance.

3. That eugenics may most profitably take the basic principles and laws worked out by the student of genetics with lower forms, and determine whether they apply to human characters, and with what limitations. That this is a more promising line for eugenic investigation to follow, than for it to attempt to deduce by statistical methods (substantially the only ones available) *general* laws of inheritance directly from human data, because (a) of the admittedly fragmentary character of such material under the best of circumstances as compared with what can be got from the breeding pen or garden with lower forms, and because (b) of the inadequacy of statistical methods to lead to the sort of knowledge desired.

Specific instances which appear to illustrate in a clear

manner the substantial truth of the above propositions are to be found in recent Mendelian studies on man. Here we see the data of human inheritance being analysed and co-ordinated by the application of certain fundamental general principles worked out by the student of genetics. Human eye colour and hair colour have been shown by Dr. and Mrs. Davenport, Holmes and others to be inherited in general accordance with simple Mendelian principles. Work on human skin colour is yielding interesting if not wholly conclusive results. The fruitfulness of this method of attacking the problem of human inheritance is particularly evident in the case of disease. Nowhere is information of an "average" character more unsatisfactory, both for the individual and for society. To find, as has been done, that certain pathological conditions and abnormalities of structure and function in man are inherited definitely and clearly along Mendelian lines is an achievement of great value.

Such a result is of significance both for the race and for the individual. If there is a definite and clear-cut segregation of the abnormal and the normal within a tainted stock, it means for the race the conservation of the useful energies of the progeny of those germinally segregated, normal individuals who, under the sweeping condemnation of tainted stocks which a purely statistical eugenics advocates, would be prevented, if possible, from reproducing themselves. To the normal individual who segregates out of a tainted stock it means a life of normal, hopeful usefulness, in the place of that haunting fear or dread of "heredity," of which the extreme manifestation has been so vividly portrayed in the *Fall of the House of Usher*.

It is the writer's opinion that the same general considerations as have been developed above in regard to the relation of biological experimentation to human inheritance apply to infant conservation as well, though here there is perhaps not so directly pertinent a body of organised biological knowledge to draw upon at once. But fundamentally the problem of infant conservation is the problem of fostering and maintaining a normal ontogenetic development of the individual human being, both ante-natal and post-natal. Here again direct scientific experimentation on the human subject is out of the question. Because of this the basic

data for all such matters as uterine and foetal physiology, effect of different environmental agents upon growth, etc., must come from animal experimentation. The eugenist may then apply these results to the human species, giving due regard to the deviations and limitations peculiar to that species. In no other way, it seems to me, can we arrive at sound, scientific, guiding principles.

By way of conclusion we may then say that the experimental study of inheritance in plants and animals is one of the main foundations upon which progress in scientific eugenics must rest. Genetics is at once the guide and the support of eugenics.

## DISCUSSION

### METHODS OF RESEARCH

BEING AN ATTEMPT TO RECONCILE THE VIEWS OF  
DR. G. ARCHDALL REID WITH THOSE OF OTHER  
BIOLOGISTS

THE science of Biology is founded upon certain facts, and neither the source from which the facts were derived nor the manner of their discovery has any bearing upon their utility so long as the facts themselves are reliable. This statement, which can scarcely be described as controversial, appears to represent the main thesis of an article entitled Methods of Research by Dr. G. Archdall Reid, published in the October number. Dr. Archdall Reid describes his paper as very controversial, but it appears to the present writer that a great deal of misunderstanding might be avoided if a clear statement were made of the views of some of those observers with whom Dr. Archdall Reid assumes himself to be in conflict.

I understand Dr. Archdall Reid to attribute to Mendelians and Mutationists the opinion that a certain class of facts, namely the facts of experiment, are in themselves of a superior order to certain other facts, namely, the facts of observation. In my own study of the writings in question I can find nothing to justify this assertion, which could scarcely have been made by anyone familiar with the numerous observations on heredity in the human species recently published by writers who must undoubtedly be described as Mendelian. The facts used by these writers are exclusively facts of observation, since in the case of the human species experiment on Mendelian lines is an impossibility. Of all the facts brought to light by students of Mendelian heredity these are the facts of greatest interest to Eugenists, and it is curious that they should have been overlooked by a contributor to the EUGENICS REVIEW. It is true, however, that many of those who have taken a prominent part in the recent march of biological progress have made great and sometimes exclusive use of facts derived from experimental observations. Of the true reason for this apparent preference no hint seems to have reached the ears of Dr. Archdall Reid. And yet the reason